Claims

[c1] 1. A reliable symbol identification method comprising:
estimating decoded symbols from a sequence of captured samples,
calculating a reliability factor of a candidate sample from values of a plurality of estimated symbols in proximity to an estimated symbol that corresponds to the candidate sample,
if the reliability factor is less than a predetermined limit, designating the candidate sample as a reliable symbol.

[c2] 5. The method of claim 1, wherein the estimating comprises:
rescattering the captured samples according to currently known ISI effects, and generating estimated symbols from the rescattered samples according to decision regions of a governing constellation.

[c3] 6. The method of claim 1, wherein the estimating comprises generating estimated symbols according to a maximum likelihood analysis of conditional probabilities of a captured sample conditioned upon all possible sets of surrounding transmitted symbols and the ranges of all possible ISI coefficients, for all possible values of the captured sample.

[c4] 7. The method of claim 1, wherein the estimation comprises generating estimated symbols according to trellis decoding based upon all possible sets of surrounding transmitted symbols and the ranges of all possible ISI coefficients, for all possible values of the captured sample.

[c5] 8. The method of claim 1, wherein the estimating comprises generating estimated symbols according to a maximum likelihood analysis of conditional probabilities of a captured sample conditioned upon all possible sets of surrounding transmitted symbols and the ranges of all possible ISI coefficients, and a uniform distribution of ISI coefficients for all possible values of the captured sample

9. The method of claim 1, wherein the estimation comprises generating estimated symbols according to a maximum likelihood analysis of conditional probabilities of a captured sample conditioned upon past symbol decisions and the ranges of all possible ISI coefficients, for all possible values of the captured sample.

[c6] 19. An equalization method, comprising:
estimating decoded symbols from captured samples based on a set of ISI

coefficient estimates, and

revising the ISI coefficients based on the decoded symbols and corresponding received sample values, wherein the contribution of each symbol-sample pair is weighted according to reliability factor of the respective captured sample.

[c7] 20. The equalization method of claim 19, wherein the weighting of a symbol-sample pair comprises:

comparing the reliability factor of a candidate sample to a threshold, and

assigning a first weight value to the symbol-sample pair if the reliability factor exceeds the threshold, and

otherwise, assigning a second weight value to the symbol-sample pair.

[c8] 21. The equalization method of claim 19, wherein the weighting of a symbol-sample pair is proportional to the reliability factor of the candidate sample.

[c9] 22. The equalization method of claim 19, wherein the weighting of a candidate sample comprises:

comparing the reliability factor of the candidate sample to a threshold, and

assigning a first weight value to the symbol-sample pair if the reliability factor exceeds the threshold, and

otherwise, assigning a second weight value to the symbol-sample pair, the second weight being is proportional to the reliability factor of the candidate sample.

[c10] 23. The equalization method of claim 19, wherein the weighting of a candidate sample comprises:

comparing the reliability factor of the candidate sample to a threshold, and

assigning a first weight value to the symbol-sample pair if the reliability factor is less than the threshold, and

otherwise, assigning a second weight value to the symbol-sample pair, the second weight being is proportional to the reliability factor of the candidate sample.

[c11] 24. The equalization method of claim 19, wherein the reliability factor of a candidate sample xn is determined from values of neighboring samples.

[c12]

38. The equalization method of claim 19, wherein the estimation comprises generating decoded symbols according to a computational approximation of:

$$Pr\left(x_n \mid h_n^k\right) = \sum_{D_{n+K_1}^{n-K_2}} \int_{\underline{a}} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{\left(x_n - \sum_{i=-K_1, i\neq 0}^{K_2} a_i h_{n-i} - h_n^k\right)^2}{2\sigma^2}} Pr(\underline{a}) Pr\left(D_{n+K_1}^{n-K_2}\right) d\underline{a},$$

, where

h_n^k represents a kth estimate of the captured sample xn,

k is an index running from a first value -K1 to a second value K2,

$D_{n+K_1}^{n-K_2} = \{h_{n+K_1}, \ldots, h_{n+1}, h_{n-1}, \ldots, h_{n-K_2}\}$

, and

Pr(a) is a probability density function of the ISI coefficients.

[c13] 44. An equalizer, comprising:

a symbol decoder having a first input for captured samples, a second input for estimated ISI coefficients and an output for estimated symbols,

an ISI estimator having a first input coupled to the symbol decoder output, a second input coupled to the first input of the symbol decoder and an output for the estimated ISI coefficients, wherein the ISI estimator estimates ISI coefficients based on the decoded symbols and corresponding received sample values, each symbol-sample pair being weighted according to reliability factor of the respective captured sample.

[c14] 45. The equalizer of claim 44, wherein the symbol decoder comprises a subtractive equalizer coupled to a decision unit.

[c15] 46. The equalizer of claim 44, wherein the symbol decoder comprises a maximum likelihood estimator coupled to a decision unit.

[c16] 47. The equalizer of claim 46, wherein the maximum likelihood analysis is made having assigned a uniform probability distribution for ISI coefficients over their ranges.

[c17] 48. The equalizer of claim 46, wherein the maximum likelihood analysis is made having assigned previously decoded symbols to occur with probability equal to one.

[c18] 49. The equalizer of claim 44, wherein the symbol decoder comprises a trellis decoder coupled to a decision unit.

[c19]

50. The equalizer of claim 44, wherein the symbol decoder generates decoded symbols according to a computational approximation of:

$$Pr\left(x_n \mid h_n^k\right) = \sum_{D_{n+K_1}^{n-K_2} \in \Omega} \int \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{\left(x_n - \sum_{i=-K_1, i\neq 0}^{K_2} a_i h_{n-i} - h_n^k\right)^2}{2\sigma^2}} Pr(\underline{a}) Pr\left(D_{n+K_1}^{n-K_2}\right) d\underline{a},$$

where,

h_n^k represents a kth estimate of the captured sample xn,

k is an index running from a first value -K1 to a second value K2,

$D_{n+K_1}^{n-K_2} = \{h_{n+K_1}, \ldots, h_{n+1}, h_{n-1}, \ldots, h_{n-K_2}\}$

, and

Pr(a) is a probability density function of the ISI coefficients.

[c20] 51. The equalizer of claim 44, further comprising a reliable symbol detector having an input coupled to the first input of the symbol decoder and an output that enables the symbol decoder.